Remarks

Replacement FIGS. 1-3 are submitted herewith to replace originally-filed informal FIGS. 1-3. No new matter is added in the drawings.

The specification is amended to correct typographical errors. Support for the corrections can be found at, for example, FIG. 3 as originally filed.

Claims 1-32 were originally filed in this application.

Claims 1-14 and 17-30 were withdrawn from consideration, without prejudice or disclaimer, as being drawn to non-elected inventions. Claims 1-14 and 17-30 are currently canceled to facilitate prosecution of the invention.

Claims 15, 16, 31, and 32 are currently amended without introducing new matter and new dependent claims 33-35 are added also without introducing new matter. Support for the amendments and new claim can be found throughout the application as originally filed, including originally filed FIGS. 1-3.

As a result claims 15, 16, and 31-35 are pending for examination with claims 15, 16, 31, and 32 being independent claims.

Rejections under 35 U.S.C. § 103

Claims 15, 16, 31, and 32 are rejected under 35 U.S.C. § 103(a) as being unpatentable over the disclosure of Mir in U.S. Patent No. 6,296,751 (hereinafter "Mir"). Mir allegedly discloses a variety of embodiments, including FIG. 8 (reproduced below), which shows a chamber bounded by an anion membrane with a cation spacer therebetween and "a cation membrane adjacent the anion membrane to split water." Because Mir states, at column 4, lines 28-31, that "[w]ater splitting occurs at the interface of an anion material or membrane with a cation material or membrane," the Examiner alleged that it would have been obvious to one having ordinary skill in the art at the time the invention was made "to modify the disclosure of

figure 8 of the Mir patent to replace the cation membrane with a cation resin, because the Mir patent teaches the equivalence between the membrane and resin."

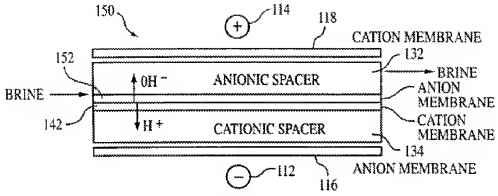

FIG. 8

Mir, at column 8, lines 38 *et seq.*, explains that concentrating channel 150 is similar to concentrating channel 140, as in FIG. 7 (reproduced below), except that anion permeable membrane 152 is placed between anionic spacer 132 and cation permeable membrane 142. Water splitting takes place between membranes 152 and 142. Cation spacer 134 is thus rendered acidic by the generated H^+ species, and preventing scale formation at anion membrane 116.

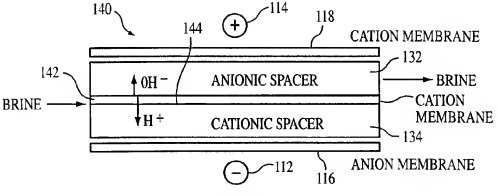

FIG. 7

Applicants disagree that claims 15, 16, 31, and 32 would have been obvious over the disclosure of Mir.

As explained in an accompanying Declaration by Gary Ganzi, one skilled in the art would not have substituted cation exchange resin material for a cation selective membrane because resins and membranes are not functional equivalents. As further explained in the accompanying Ganzi Declaration, substituting resin for the membrane would contradict the objectives of Mir because the resultant configuration would not sufficiently lower the pH at the surface of anion membrane 116. Therefore, the *prima facie* case of obviousness is improper because the alleged motivation is defective. Further, any alleged *prima facie* case of obviousness is rebutted because one skilled in the art would have recognized that doing so would destroy a feature promoted by Mir.

The suggestion for substituting the anion membrane 142 for cationic spacer 134 would contradict the objectives of Mir. Mir notes that the concentrating channel configuration at FIG. 8 is similar to the concentrating channel 140 configuration illustrated at FIG. 7. (See Mir at column 8, lines 39-40.) Concentrating channel 140 has a cation permeable membrane 142 between anionic spacer 132 and cationic spacer 134. (Mir at column 8, lines 24-27.) Membrane 142 creates two separate brine streams and water splitting occurs at interface 144 of anionic spacer 132 and cation permeable membrane 142, which results in two separate concentrate streams. (Mir at column 8, lines 27-30.) The slightly alkaline, first concentrate stream flowing through the anion exchanging layer contains calcium but no inorganic carbon and thus cannot form scale; the slightly acidic, second concentrate stream flowing through the cation exchanging layer contains inorganic carbon but no calcium and cannot form scale. (Mir at column 8, lines 31-37.) Because the same conditions are likewise present in the concentrating channel 150 of FIG. 8, removing or substituting the cationic permeable membrane 142 for cationic spacer 134 would hinder the scale resistant approach disclosed by Mir. In particular, removing cation membrane 134 (as suggested by the Examiner) would not necessarily inhibit inorganic anionic HCO_3^{2+} from the alkaline, first concentrate stream flowing through the anion exchanging layer,

which would result in scale formation. Thus, one skilled in the art would not have been motivated to substitute the resin for the membrane as suggested by the Examiner.

The subject matter of independent claim 15 is directed to an electrochemical device comprising a first compartment comprising electroactive media that is substantially free of anion-exchange resin and is bounded by first and second anion-selective membranes on each side thereof, a second compartment defined at least partially by the first anion-selective membrane, the second compartment comprising a first mixed bed of cation exchange resin and anion exchange resin.

The *prima facie* case of obviousness is improper because the cited passage of Mir fails to disclose a compartment comprising electroactive media substantially free of anion-exchange resin and bounded by anion-selective membranes on each side of the compartment. Instead, Mir explains that the concentrating channel 150 (illustrated in FIG. 8) is bounded by an anion membrane 116 and a cation membrane 118. Mir further explains that compartment 150 contains an anionic spacer 132 comprising anion exchange material. Mir also notes that concentrating channel 150 comprises anion membrane 152. (See Mir at column 8, lines 38-48 and at column 8, lines 10-12.)

The cited passage fails to support the *prima facie* case of obviousness because it does not teach or suggest a compartment bounded by anion-selective membranes and also does not teach or suggest a compartment without anion exchange resin. To be sure, Mir also fails to disclose an electrochemical device with a first compartment bounded by first and second anion-selective membranes, and free of anion-exchange resin, along with a second compartment with mixed resin therein and bounded by the first anion-selective membrane. Even if Mir could be considered to disclose a compartment defined by anion membranes 116 and 152, and including cationic spacer 134 and cation membrane 142, the *prima facie* case of obviousness cannot be supported because there is no teaching or suggestion for the second compartment including a mixed bed of cation exchange resin and anion exchange resin. Therefore, the subject matter of independent claim 15 would not have been obvious over Mir.

The subject matter of independent claim 16 is directed to an electrochemical device comprising a trapping compartment consisting essentially of cation-exchange resin and anion-selective membranes and an electrode compartment fluidly connected to an outlet of the trapping compartment. As noted above, Mir discloses a concentrating channel 150 defined by a cation membrane 118 and an anion membrane 116. As noted above, Mir does not disclose or suggest a compartment defined by anion-selective membranes and filled with cation-exchange resin. Mir also does not teach or suggest an electrode compartment connected to an outlet of the trapping compartment.

Thus, because Mir fails to teach or suggest a compartment consisting essentially of anion-selective membranes and cation-exchange resin, the *prima facie* case of obviousness is improper. The *prima facie* case of obviousness is also improper because Mir fails to teach or suggest an electrode compartment connected to an outlet of the trapping compartment.

The subject matter of independent claim 32 is similarly directed to a method of facilitating liquid treatment comprising providing an electrochemical device comprising a trapping compartment consisting essentially of cation-exchange resin and anion-selective membranes and an electrode compartment fluidly connected downstream of the trapping compartment. Therefore, the subject matter of independent claim 32 would not have been obvious over the disclosure of Mir for at least the same reasons as noted above with regard to claim 16.

The subject matter of independent claim 31 is directed to a method of facilitating liquid treatment comprising providing an electrochemical device comprising at least one compartment that is at least partially filled with cation-exchange resin and bounded by anion-selective membranes on each side thereof, and connecting a power supply to the electrochemical device, the power supply configured to provide a reversible electrical current to the electrochemical device. Mir, however, discourages utilizing polarity reversal techniques. (See, for example, Mir

at column 3, lines 23 *et seq.*) Further, one skilled in the art would not have utilized reversible polarity applications in the configurations of Mir. If the polarity of the applied current were reversed in the configuration of FIG. 8, cationic spacer 134 would inhibit transport of hydroxyl species (OH^-) toward new anode 112 resulting in an increase in pH in cationic spacer 134 and an accompanying increase in the likelihood of scale formation therein. Further, H^+ species would not migrate toward anion membrane 116 but, instead, would migrate toward electrode 114. Thus, no scale inhibition would be realized at anion membrane 116, which defeats a stated objective of Mir. Beyond that, the ions in the sub-channels would tend to concentrate at the interface between the juxtaposed membranes 152 and 142. Because no bulk liquid is available to flow between the two juxtaposed membranes, the resulting reversed current operation would cause scaling and physical membrane damage at the interface.

Thus, the *prima facie* case of obviousness is improper because Mir fails to teach or suggest each and every limitation in the manner recited, and any *prima facie* case of obviousness is rebutted because Mir discourages reverse polarity techniques and also because one skilled in the art would have recognized that the configuration of Mir could not utilize such reverse polarity techniques.

Accordingly, reconsideration and withdrawal of the rejection of claims 15, 16, 31, and 32 under 35 U.S.C. § 103 is respectfully requested.

New claims

New dependent claims 33-35 recite further features of the invention. These dependent claims are patentable for at least the same reasons noted above.

Conclusion

In view of the foregoing Amendments and Remarks, this application is in condition for allowance; a notice to this effect is respectfully requested. If the examiner believes that the application is not in condition for allowance, the examiner is requested to call Applicants' attorney at the telephone number listed below.

If this Response is not considered timely filed and if a request for an extension of time is otherwise absent, Applicant hereby requests any necessary extension of time. If there is a fee occasioned by this Response, including an extension fee that is not covered by an enclosed check, please charge any deficiency to Deposit Account No. 50/2762.

Respectfully submitted,
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